

What is Particulate Matter?

Learn what Particulate Matter is, where it comes from, how it is measured and how it affects health.

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Particulate matter (PM) refers to solid and liquid particles suspended in air, classified by size into classes like PM10, PM2.5 and PM1.0. PM2.5 is the most widely used of these metrics. PM2.5 comprises all particles with a diameter of 2.5 µm or less, including PM1.0. PM2.5 concentrations are therefore always equal to or higher than PM1.0 concentrations.

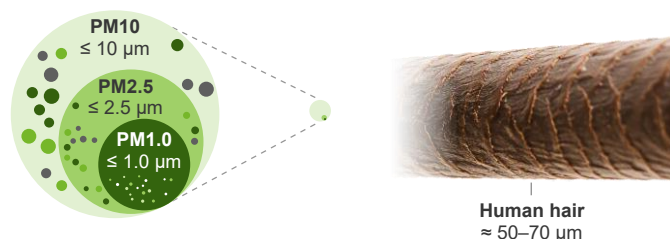


Figure 1: Size comparison of PM1.0, PM2.5, PM10 and human hair.

Sources of PM2.5

PM2.5 originates from both natural and human-made sources.

Typical outdoor sources include:

- Wildfires and agricultural burning
- Vehicle exhaust and tire or brake wear
- Combustion processes (e.g. for heating)
- Construction activities and resuspended dust

Typical indoor sources include:

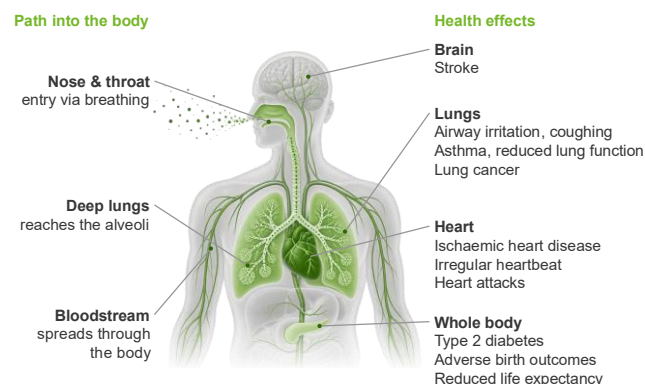
- Cooking, frying and grilling
- Candles and fireplaces
- Tobacco smoke
- Outdoor air entering the building

What is the unit of PM2.5 and how is it measured?

PM2.5 concentration is typically reported in micrograms per cubic metre of air ($\mu\text{g}/\text{m}^3$). This unit originates from the gravimetric reference method, where air is drawn through a size separator and a filter. The size separator ensures that only particles of the desired size fraction reach the filter. After a defined sampling period (typically 24 hours), the filter is weighed and the collected particle mass is used to determine the PM2.5 concentration. Nowadays, most air quality monitors and low-cost particle sensors use optical light scattering to estimate particle concentrations in real time. The unit, however, has remained unchanged.

What health risks does PM2.5 pose?

Particulate matter is the most harmful air pollutant and the leading environmental risk factor for premature death worldwide^(2,3). Because of their small size, these particles can penetrate deep into the lungs, and some may even enter the bloodstream⁽¹⁾.



Exposure to elevated PM2.5 concentrations has been associated with:

Short-term exposure (hours to days):

- Irritation of the airways, coughing and difficulty breathing⁽¹⁾
- Aggravated asthma and reduced lung function⁽¹⁾
- Irregular heartbeat and non-fatal heart attacks^(1,4)

Long-term exposure (months to years):

- Ischaemic heart disease and stroke^(2,3,4)
- Lung cancer^(2,3)
- Type 2 diabetes and adverse birth outcomes⁽³⁾
- Reduced life expectancy⁽⁴⁾

What PM2.5 concentrations are considered high?

The health impact of PM2.5 depends on both the concentration and the duration of exposure. The table below shows how the US EPA Air Quality Index (AQI) classifies 24-hour average PM2.5 concentrations.

AQI	Category	PM2.5 [$\mu\text{g}/\text{m}^3$]
0-50	Good	0.0-9.0
51-100	Moderate	9.1-35.4
101-150	Unhealthy for sensitive groups	35.5-55.4
151-200	Unhealthy	55.5-125.4
201-300	Very Unhealthy	125.5-225.4
301+	Hazardous	≥ 225.5

(Note: Other organizations and countries, such as the WHO and the EU, use different limits.)

Further Reading:

Whitepaper – Limits of PM2.5 Optical Sensors and Gravimetric Comparison:
[Whitepaper Optical PM Sensing Limits of Optical Sensors.pdf](#)

Sources:

- (1): US EPA, Health and Environmental Effects of Particulate Matter (PM)
- (2): WHO, Ambient air pollution: Health Risks
- (3): Health Effects Institute, Health Impacts of PM2.5 | State of Global Air
- (4): Brook et al., Particulate Matter Air Pollution and Cardiovascular Disease